DETECTION OF BIOLOGICAL AEROSOLS BY MALDI ON-LINE AEROSOL TOF MS

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ABSTRACT

Matrix-assisted laser desorption/ionisation (MALDI) mass spectra were obtained from single biological aerosol particles using an aerosol time-of-flight mass spectrometer (ATOFMS). The inlet to the ATOFMS was coupled with an evaporation/condensation flow cell that allowed the aerosol to be coated with matrix material as the sampled stream entered the spectrometer. Mass spectra were generated from aerosols of gramicidin-S, erythromycin, insulin and cytochrome c, or of *Bacillus subtilis* var niger spores. The results give a proof of principle that MALDI ATOFMS can provide nearly real-time identification of biological aerosols.

INTRODUCTION

Single particle aerosol mass spectrometry has developed since the late 1980s.[1] A system for aerosol mass spectrometry, was originally constructed at the Delft University of Technology.[2] This system, the ATOFMS, consists of a particle-beam like aerosol inlet, a HeNe laser for particle sizing and ionization triggering, an UV ionization laser and a time-of-flight mass analyzer. This system was recently further modified to achieve bio-aerosol detection, with the ultimate goal of establishing a generic bio-aerosol alarm.

RESULTS

First, a device was constructed for the on-line coating of aerosol particles with a matrix compound. This allowed more efficient ionization, through on-line aerosol MALDI MS.[3] Low mass peptides, erythromycin (~700 Da) and gramicidin S (~1,040 Da) and glycan type material from *Bacillus subtilus* var niger spores (~1,230 Da) was observed in typical MALDI-ATOFMS mass spectra.

Next, the upper mass range limit of 2000 Da was extended by instrument modifications to the mass spectrometer. With the extended mass range and matrix addition, spectra of larger peptides were obtained; in Figure 1, an example is shown of a spectrum obtained from cytochrome c aerosol.

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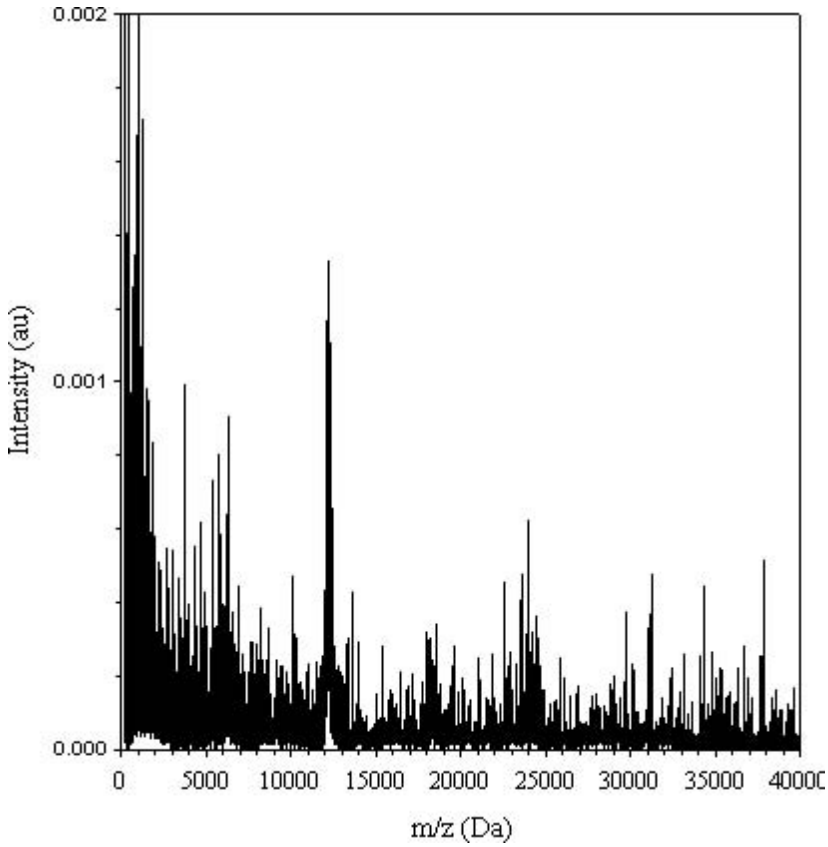

Figure 1. MALDI-ATOFMS spectrum obtained from an aerosol of cytochrome c (MW_{av} 12,270 Da), premixed with ferulic acid matrix.

Most biomarker signals from bacteria, as observed in common MALDI MS, fall in the mass range up to 30,000. Therefore, observations of proteins in this range, with the MALDI-ATOFMS, is a proof of principle that bacteria fingerprints can be obtained in real-time (seconds).

Currently, the MALDI-ATOFMS system is being modified for selective ionization of bio-aerosol particles, by on-the-flight distinction of biological particles from common organic and inorganic particles. This selective ionization will be used to increase the detection efficiency for bio-aerosol particles.

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